PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) VALVE ARRANGEMENTS FOR PISTON ENGINES

(71) We, SULZER BROTHERS LIMITED, a Company organised under the Laws of Switzerland, of Winterthur, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to valve arrangements for piston engines consisting of a valve and a valve seat having co-operating bearing surfaces.

The bearing surfaces of valves and valve seats for piston engines have already been protected by a coating of a hard-facing alloy, for example the material known by the Registered Trade Mark "Stellite", considerably lengthening their lives. However, the previously employed coatings are not entirely satisfactory for diesel engines operating on heavy oil because of high-temperature corrosion due to combined -vanadium-sodium sulphur attack. Attempts have been made to overcome this difficulty by using stronger and harder coatings but problems have arisen in connection with the adhesion of the hard alloys to the relatively soft austenitic or ferritic base materials of the components in the valve arrangement.

According to the present invention, a valve arrangement for a piston engine consists of a valve and a valve seat having co-operating bearing surfaces at least one of which carries a metallic coating comprising an outer layer of a heat resisting metallic material having a hardness of over 700 kp/mm^2 Vickers and an intermediate layer of another metallic material whose hardness is between 400 and 600 kp/mm^2 Vickers and is greater than that of the base material carrying the coating.

The use of an intermediate layer provides both a good connection between the very hard material on the surface and the base material of the component and also a long life during operation, so that in some circumstances liquid cooling, which would otherwise be necessary, can be omitted.

The base material may be an austenitic or ferritic steel, depending on the operating conditions.

Preferably, the material of the outer layer has a corrosion-resistant surface which is inert as regards corrosive substances to which it is exposed during operation such as those present in heavy oil. In this way, the formation of deposits on the bearing surface is largely eliminated. This is desirable because deposits on the bearing surface bring a risk that eventually, due to the repeated collisions between the valve and the valve seat, part of the layer of deposits will chip off, allowing hot gases to blow through from the combustion chamber of the cylinder. The effect of these gases, which is comparable to the action of a welding torch, soon leads to destruction of the valve components.

The materials for the outer layer of the armour, which have the properties mentioned, include the non-ferrous-based high-alloy metals known as "superalloys", which have exceptionally high hardness of more than 700 kp/mm^2 Vickers and may have a nickel, cobalt or tungsten base.

The invention may be carried into practice in various ways but two valves embodying the invention will now be described by way of example with reference to the accompanying drawing which represents either of the two valves and is a partial section through the edge of the valve disc.

The drawing shows a valve disc 1 having a diameter D of 130 mm and carrying a protective coating on the surface which cooperates with the valve seat. The protective coating consists of an intermediate layer 2 having a maximum thickness B of 3 mm and an outer layer 3 having a thickness A of between 1.1 and 1.2 mm.

The details of the two examples of valve

having the construction shown in the drawing will now be expounded.

Example 1

An exhaust valve made from high-alloy chrome-nickel steel for a diesel engine was provided with a layer of a hard-facing alloy supplied under the name "Haynes Stellite 6" by the Union Carbide Corporation.

The valve disc was then, after machining of the "Stellite", sandblasted and heated to between 700 and 750°C, at which temperature an outer coating of a nickel-base superalloy was applied by flame spraying. This coating was 1.1 to 1.2 mm thick after final machining of the valve bearing surface using the diamond cutting method.

The compositions of the materials of the valve were as follows:

Base material (austenitic steel):
18.5% Cr, 0.45% Cr, 2.5% Si, 1.2% Mn, 9% Ni, 1% W, rest Fe
Intermediate layer ("Stellite 6)":
28% Cr, 1% C, 4% W, rest Co.
Outer layer (nickel-base superalloy):
16.5% Cr, 0.9% C, 4.3% Si, 3.8% Fe, 3.3% B, rest Ni.

The hardness of the outer layer was between 770 and 820 kp/mm² Vickers, the hardness of the intermediate layer between 400 and 450 kp/mm² Vickers, and the hardness of the chrome-nickel steel of the valve disc between 260 and 280 kp/mm² Vickers.

Valves of this construction were installed as exhaust valves in a 6-cylinder trunk-piston diesel engine operating on heavy oil. After two 1000-hour endurance tests on heavy oil, they showed no sign of incipient corrosion or any other damage. The valves were operating without any special liquid cooling.

Example 2

A valve was made in substantially the same way from the following materials:

Base material: ferritic steel.
Intermediate layer ("Stellite 32" from the Union Carbide Corporation):
25% Cr, 1.7% C, 1% Si, 1% Mn, 1% Fe, 22% Ni, 12% W, remainder Co.
Outer-layer (tungsten-base superalloy):
13% Co; 87% WC.

The outer layer was applied by flame spraying after preheating of the valve disc to 500 to 600°C.

In this example, the hardness of the outer layer was between 1100 and 1200 kp/mm² Vickers, the hardness of the intermediate layer was between 400 and 420 kp/mm² Vickers, and the hardness of the base material was between 350 and 380 kp/mm² Vickers.

The valve, which was water-cooled, exhibited similar properties during operation to those of the valve in Example 1.

WHAT WE CLAIM IS:—

1. A valve arrangement for a piston engine consisting of a valve and a valve seat having co-operating bearing surfaces at least one of which carries a metallic coating comprising an outer layer of a heat resisting metallic material having a hardness of over 700 kp/mm² Vickers and an intermediate layer of another metallic material whose hardness is between 400 and 600 kp/mm² Vickers and is greater than that of the base material carrying the coating.

2. A valve arrangement as claimed in Claim 1 in which the material of the outer layer has a corrosion-resistant surface which is substantially inert as regards corrosive substances present in heavy oil.

3. A valve arrangement as claimed in Claim 1 or Claim 2 in which the material of the outer layer is a non-ferrous based alloy.

4. A valve arrangement as claimed in Claim 3 in which the material of the outer layer is a nickel base alloy.

5. A valve arrangement as claimed in Claim 3 in which the material of the outer layer is a cobalt-base alloy.

6. A valve arrangement as claimed in Claim 3 in which the material of the outer layer is a tungsten-base alloy.

7. A valve arrangement as claimed in any of Claims 3 to 6 in which the material of the intermediate layer is a hard-facing alloy containing more than 20% metallic carbides.

8. A valve arrangement as claimed in any of the preceding claims in which the base material is an austenitic steel.

9. A valve arrangement as claimed in any of Claims 1 to 7 in which the base material is a ferritic steel.

10. A piston engine valve substantially as described herein with reference to the accompanying drawing, the materials of the valve being substantially as described herein with reference to foregoing Example 1 or Example 2.

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1290986 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*